

**OROVILLE FERC RELICENSING
(PROJECT No. 2100)**


**INTERIM REPORT
SP-F3.2 TASK 2
SP-F21 TASK 1**

**APPENDIX A
MATRIX OF LIFE HISTORY AND HABITAT REQUIREMENTS FOR
FEATHER RIVER FISH SPECIES**

**LITERATURE REVIEW OF LIFE HISTORY AND
HABITAT REQUIREMENTS FOR
FEATHER RIVER FISH SPECIES**

SMALLMOUTH BASS

JANUARY 2003

Element	Element Descriptor	General	Feather River specific
General			
common name (s)	English name (usually used by fishers and laypeople).	Smallmouth bass	
scientific name (s)	Latin name (referenced in scientific publications).	<i>Micropterus dolomieu</i>	
taxonomy (family)	Common name of the family to which they belong. Also indicate scientific family name.	Sunfish and bass - <i>Centrarchidae</i>	
depiction	Illustration, drawing or photograph.		
range	Broad geographic distribution, specifying California distribution, as available.	Smallmouth bass are native to the Upper Mississippi drainage south through Arkansas, and in the Great Lakes watershed. They were introduced to most of U.S. and worldwide. In California they are present in larger tributaries at elevation of 328-3,280 ft (100-1,000 m) (Moyle 2002).	
native or introduced	If introduced, indicate timing, location, and methods.	Introduced into Central California in 1874 in San Mateo County (Moyle 2002).	

Element	Element Descriptor	General	Feather River specific
ESA listing status	Following the categories according to California Code of Regulations and the Federal Register, indicate whether: SE = State-listed Endangered; ST =State-listed Threatened; FE = Federally listed Endangered; FT = Federally-listed Threatened; SCE = State Candidate (Endangered); SCT = State candidate (Threatened); FPE = Federally proposed (Endangered); FPT = Federally proposed (Threatened); FPD = Federally proposed (Delisting); the date of listing; or N = not listed.	Smallmouth bass are not listed.	
species status	If native, whether: Extinct/extirpated; Threatened or Endangered; Special concern; Watch list; Stable or increasing. If introduced, whether: Extirpated (failed introduction); highly localized; Localized; Widespread and stable; Widespread and expanding.	Smallmouth bass are widespread and stable (Moyle 2002).	
economic or recreational value	Indicate whether target species sought for food or trophy. Whether desirable by recreational fishers, commercial fishers, or both.	Smallmouth bass are a target species for recreational fishers.	
warmwater or coldwater	Warmwater if suitable temperature range is similar to basses; coldwater if suitable temperature range is similar to salmonids.	Warmwater.	
pelagic or littoral	Environment: Pelagic - living far from shore; Littoral - living near the shore.		
bottom or water column distribution	Environment: bottom (benthic) or along water column.	Water column.	
lentic or lotic	Environment: Lentic - pertaining to stagnant water, or lake-like; Lotic - moving water, or river-like.	Lentic.	

Element	Element Descriptor	General	Feather River specific
Adults			
life span	Approximate maximum age obtained.	Although a 15-year old smallmouth bass has been recorded, fish over 7 years of age are uncommon (Edwards et al. 1983).	
adult length	Indicate: Length at which they first reproduce; average length and maximum length the fish can attain.	<p>At the end of the first year, smallmouth bass measure between 2.4-7.1 inches (6-18 cm) TL. By the end of 2nd year, they measure between 5.5-10.6 inches (14-27 cm) TL, while by the end of their 3rd year, smallmouth bass measure between 7.5-10.6 inches (19-27 cm) TL. In their 4th year, smallmouth bass measure between 9.8-16.1 inches (25-41 cm) TL. Growth in Central Valley reservoirs is excellent and so 4-year-old smallmouth bass typically measure 13.8-15.4 inches (35-39 cm) (Moyle 2002).</p> <p>Smallmouth bass range in size from 3.5 inches (90 mm) at age-one to 18 inches (457 mm) at age 15 (Beamesderfer et al. 1995).</p> <p>Age of smallmouth bass at sexual maturity varies throughout its range and is related to latitude and growth rate of local populations. Males and females mature at age-2 in the south and at age-6 in the north. In the central part of their range, males mature at age-3 to age-4, while females mature at age-4 or age-5 (Edwards et al. 1983).</p>	
adult weight	Indicate: Weight at which they first reproduce; average weight and maximum weight the fish can attain.	The largest smallmouth bass caught in California weighed 9 pounds (4.1 kg) (Moyle 2002).	
physical morphology	General shape of the fish: elongated, fusiform, laterally compressed, etc.	Smallmouth bass are fairly streamlined for a bass, but have stocky bodies and mouths that do not reach the hind margin of the eye. Their dorsal fin is spiny and the spiny portion is slightly rounded (Moyle 2002).	
coloration	Indicate color, and color changes, if any, during reproduction phase.	Smallmouth bass are greenish-brown to bronze, with no conspicuous horizontal stripes on the sides, but often faint vertical dark, mottled bars. They have a white belly and three dark bands radiating from reddish eyes. Young-of-year are darker than adults with plain coloration, and a tricolored tail (Moyle 2002).	

Element	Element Descriptor	General	Feather River specific
other physical adult descriptors	Unique physical features for easy identification.	Smallmouth bass are fairly streamlined for bass (Moyle 2002).	
adult food base	Indicate primary diet components.	Smallmouth bass feed mainly on crayfish, but also eat fish, amphibians, and insects (Moyle 2002).	
adult feeding habits	Indicate whether plankton eater, algae eater, bottom feeder, piscivorous, active hunter, ambush predator, filter feeder. Night, day, dusk or dawn feeder.	Smallmouth bass are active hunters (Moyle 2002).	
adult in-ocean residence time	For anadromous species, age when they migrate to the ocean and duration spent in the ocean before returning to freshwater to spawn.	N/A	
adult habitat characteristics in-ocean	For anadromous species, description of the ocean habitat utilized: whether along major current systems, gyres, pelagic (beyond continental shelves) and neritic (above continental shelves) zones, etc.	N/A	
Adult upstream migration (immigration)			
range of adult upstream migration timing	Time of year adults migrate upstream. If applicable, indicate for various runs.	N/A	
peak adult upstream migration timing	Time of year most adults migrate upstream. If applicable, indicate for various runs.	N/A	
adult upstream migration water temperature tolerance	Range of water temperatures allowing survival. Indicate stressful or lethal levels.	N/A	
adult upstream migration water temperature preference	Range of suitable, preferred or reported optimal water temperatures. Indicate whether literature, observational, or experimental.	N/A	

Element	Element Descriptor	General	Feather River specific
Adult holding (freshwater residence)			
water temperature tolerance for holding adults	Range of water temperatures allowing survival. Indicate stressful or lethal levels.	Rapid growth of smallmouth bass occurs at water temperatures as high as 84.2°F (29°C). Water temperatures ranging from 80.6°F-87.8°F (27°C -31°C) are selected under lab conditions. Water temperatures greater than 95°F (35°C) are considered stressful, while water temperatures greater than 100.4°F (38°C) are lethal. Populations rarely establish where water temperatures do not exceed 66.2°F (19°C) in summer for extended periods. In California, smallmouth bass populations typically occur in areas where summer water temperatures are typically 69.8°F-71.6°F (21°C - 22°C) (Moyle 2002).	
water temperature preference for holding adults	Range of suitable, preferred or reported optimal water temperatures. Indicate whether literature, observational, or experimental.	Reported optimum water temperatures for adult growth range from 77°F-80.6°F (25°C -27°C) (Moyle 2002).	
water depth range for holding adults	Reported range of observed (minimum and maximum) water depth utilization.	Smallmouth bass tend to concentrate in areas with water depths of 3.3-32.8 ft (1-10 m) (Moyle 2002). Standing crop of bass is generally largest in pools deeper than 3.9 ft (1.2m). Reported optimum lacustrine habitat is characterized by large, clear lakes and reservoirs with an average water depth of greater than 30 ft (9m) (Edwards et al. 1983).	
water depth preference for holding adults	Reported range of most frequently observed water depth utilization.		
substrate preference for holding adults	If bottom dwellers, indicate substrate: mud, sand, gravel, boulders, aquatic plant beds, etc. If gravel, indicate range or average size of gravel.	Smallmouth bass concentrate in narrow bays or in areas along shore where rocky shelves project under water (Moyle 2002).	
water velocity range for holding adults	Reported range of observed (minimum and maximum) water velocity utilization.	In a Tennessee reservoir, seasonal mean water velocity in bass habitats ranged from 0.36-5.7 ft/sec (10.9-32.0 cm/sec) (Edwards et al. 1983).	
water velocity preference for holding adults	Reported range of most frequently observed water velocity utilization.		

Element	Element Descriptor	General	Feather River specific
other habitat characteristics for holding adults	General description of habitat (e.g. turbid or clear waters, lentic or lotic, presence of aquatic plant beds, debris, cover, etc.).	Smallmouth bass prefer large, clear lakes and clean streams and rivers with abundant cover. Smallmouth bass are most abundant in streams with moderate gradients 0.75 to 4.70 m/km. Smallmouth bass have become established in a number of reservoirs, and they are usually most abundant in the upstream end of the reservoirs (Moyle 2002).	
timing range for adult holding	Time of year (earliest-latest) and duration of stay from upstream migration to spawning.	N/A	
timing peak for adult holding	Time of year when maximum number of adults are present before spawning.	N/A	
Spawning			
fecundity	Average or range in the number of eggs females lay in a spawning season.	Fecundity ranges from 2,000-21,000 eggs/female depending on size (Moyle 2002). Fecundity is approximately 20,825 eggs/female (Wang 1986).	
nest construction	Location and general description of nest - substrates, aquatic plants, excavations, crevices, habitat types, etc.	Males start fanning out nest depressions 11.8-23.6 inches (30-60 cm) in diameter with their fins when water temperatures reach 55.4°F-60.8°F (13°C -16°C). Nests are built on rubble, gravel, or sand bottoms at depths of about 3.3 ft (1 m) near submerged logs, boulders or other cover. Nests have been recorded on substrates at depths of 1.6-16.4 ft (0.5-5 m) (Moyle 2002).	
nest size	Size and average dimensions of the nest.	Smallmouth bass nests range from 11.8-23.6 inches (30-60 cm) in diameter (Wang 1986).	
spawning process	Indicate whether nest builder, broadcast spawner, or other.	Female releases 10-50 eggs in 4 to 45 second intervals, until all eggs have been released. When spawning is finished, the female leaves the nest or is chased away by male (Moyle 2002).	

Element	Element Descriptor	General	Feather River specific
spawning substrate size/characteristics	Range of substrates used during spawning (e.g. mud, sand, gravel, boulders, beds of aquatic plants). Indicate presence of plant/wood debris, crevices at spawning sites. If gravel, indicate range of average size.	Spawning substrates include gravel, rock, and rubble (Wang 1986).	
preferred spawning substrate	Indicate preferred spawning substrate (e.g. mud, sand, gravel, boulders, plant bed, etc).	Suitable spawning substrate includes rubble, gravel, and sand bottoms approximately 3.3 ft (1 m) in depth, near submerged logs, boulders or other cover (Moyle 2002).	
water temperature tolerance for spawning	Range of water temperatures allowing survival. Indicate stressful or lethal levels.	<p>In Wisconsin, spawning and nest building begin at a water temperature of 59°F (15°C) and continue until water temperatures reach 68°F-71.6°F (20°C-22°C) (Baylis et al. 1993).</p> <p>Water temperatures for spawning range from 54.5°F-74.3°F (12.5°C -23.5°C) (Graham et al. 1986).</p> <p>Males begin fanning out nest depressions with their fins when water temperatures reach 55.4°F-60.8°F (13°C - 16°C).</p>	
water temperature preference for spawning	Range of suitable, preferred or reported optimal water temperatures. Indicate whether literature, observational, or experimental derivation.		
water velocity range for spawning	Minimum and maximum speed of water current the spawning fish can tolerate.	Nesting and reproduction can be disrupted by high flows, either because embryos and fry are washed out of the nests or because lower water temperatures reduce spawning activity (Moyle 2002).	
water velocity preference for spawning	Preferred water current (flow velocity) during spawning.		
water depth range for spawning	Reported range of observed (minimum and maximum) water depth utilization.	Usually smallmouth bass males usually build nests on rubble, gravel, or sand bottoms at depths of approximately 3.3 ft (1m). However, nests have been recorded on varying substrates at depths ranging from 1.6-16.4 ft (0.5-5 m). Spawning occurs in the nest (Moyle 2002).	
water depth preference for spawning	Reported range of most frequently observed water depth utilization.		

Element	Element Descriptor	General	Feather River specific
range for spawning timing	Earliest and latest time of season or year in which spawning occurs.	In Northern California reservoirs, most spawning occurs in May and June, but in streams, spawning may extend into July depending on flow and water temperatures (Moyle 2002). Smallmouth bass spawning occurs from late April through mid-July (Graham et al. 1986). Smallmouth bass spawning occurs from mid April- early June (Lukas et al. 1995).	
peak spawning timing	Time of year most fish start to spawn.	Peak spawning occurs in late spring (Moyle 2002).	
spawning frequency (iteroparous/semelparous)	Semelparous - producing all offspring at one time, such as in most salmon. Usually these fish die after reproduction. Iteroparous - producing offspring in successive, e.g., annual or seasonal batches, as is the case in most fishes.	Smallmouth bass are iteroparous.	
Incubation/early development			
egg characteristics	Shape, size, color, in clusters or individuals, stickiness, and other physical attributes.	Smallmouth bass eggs are demersal and adhesive, spherical, and attach to rocky surfaces in the nest. The yolk is light amber or pale yellow (Wang 1986).	
water temperature tolerance for incubation	Range of water temperatures allowing survival. Indicate stressful or lethal levels.		
water temperature preference for incubation	Range of suitable, preferred or reported optimal water temperatures. Indicate whether literature, observational, or experimental derivation.		
time required for incubation	Time duration from fertilization to hatching. Note: Indicate at which temperature range. Incubation time is temperature-dependent.	Eggs hatch in 10 day at 55°F (12.8°C) and in 2.5 days at 78.1°F (25.6°C) (Wang 1986).	
size of newly hatched larvae	Average size of newly hatched larvae.	Length of larvae at hatching is 0.18 inches (4.6 mm) TL (Wang 1986).	
time newly hatched larvae remain in gravel	Time of year of hatching, and duration between hatching and emergence from gravel.	Newly hatched larvae remain in the nest for several days (Wang 1986).	

Element	Element Descriptor	General	Feather River specific
		Fry remain on the bottom of nest for 3-4 days before they start to become active and rise off the bottom of the nest (Moyle 2002).	
other characteristics of larvae	Alevin -- early life history phase just after hatching (larva) when yolk-sac still present.		
timing range for emergence	Time of year (earliest-latest) hatchlings (larvae and alevins) leave or emerge from the nesting/hatching (gravel) sites.	Once fry become active and rise off the bottom of the nest, the male smallmouth bass of the nesting pair herds them into a shoal, and guards them for 1-4 weeks (Moyle 2002).	
timing peak for emergence	Time of year most hatchlings emerge.		
size at emergence from gravel	Average size of hatchlings at time of emergence.	By the time fry reach 0.8-1.2 inches (2-3 cm) TL they are too difficult for the male of the nesting pair to herd, and they soon disperse into shallow water (Moyle 2002).	
Juvenile rearing			
general rearing habitat and strategies	General description of freshwater environment and rearing behavior.		
water temperature tolerance for juvenile rearing	Range of water temperatures allowing survival. Indicate stressful or lethal levels.	Juvenile smallmouth bass tolerate water temperatures ranging from 77°F-78.8°F (25°C -26°C) (Coutant et al. 1983).	
water temperature preference for juvenile rearing	Range of suitable, preferred, or reported optimal water temperatures. Indicate whether literature, observational, or experimental derivation.		
water velocity ranges for rearing juveniles	Reported range of observed (minimum and maximum) water velocity utilization.	Optimal water velocity for young-of-year bass is 0.26-0.42 ft/sec (80-130 mm/sec) (Moyle 2002).	
water velocities preferred by rearing juveniles	Reported range of most frequently observed water velocity utilization.		
water depth range for juvenile rearing	Reported range of observed (minimum and maximum) water depth utilization.		

Element	Element Descriptor	General	Feather River specific
water depth preference for juvenile rearing	Reported range of most frequently observed water depth utilization.		
cover preferences for rearing juveniles	Type of cover for protection from predators used by rearing juveniles (e.g., crevices, submerged aquatic vegetation, overhanging vegetation, substrate cover, undercover bank, small woody debris, large woody debris).	Juveniles utilize sandy shoals, rocky areas, and shallow stream pools with sand and rocky bottoms, and are continuously guarded by the male parent for 1-3 weeks (Wang 1986). Male guard fry of up to 1 inch (26 mm) for up to 4 weeks (Coutant et al. 1983).	
food base of juveniles	Indicate primary diet components. Also indicate the diet changes, if any, as growth occurs.	Fry feed on crustaceans and aquatic insects until they reach 1.2-2 inches (3-5 cm) TL. At 3.9-5.9 inches (10-15 cm) they feed on larger prey, such as crayfish and fish (Moyle 2002).	
feeding habits of rearing juveniles	Indicate whether plankton eater, algae eater, bottom feeder, piscivorous, active hunter, ambush predator, filter feeder. Night, day, dusk or dawn feeder. Also indicate change of feeding habits growth occurs.	Juvenile smallmouth bass are active hunters (Wang 1986).	
predation of juveniles	Indicate which species prey on juveniles.	Pikeminnow may prey on smallmouth bass fry (Moyle 2002).	
timing range for juvenile rearing	Range of time of year (months) during which rearing occurs.		
timing peak for juvenile rearing	Time of year (months) during which most rearing occurs.		
Juvenile emigration			
time spent in fresh water prior to emigrating	Duration (in years and/or months) from emergence to emigration to the ocean.	N/A	
water temperature tolerances during emigration	Range of water temperatures allowing survival. Indicate stressful or lethal levels.	N/A	

Element	Element Descriptor	General	Feather River specific
water temperature preferences during emigration	Range of suitable, preferred or reported optimal water temperatures. Indicate whether literature, observational, or experimental derivation.	N/A	
emigration timing range	Time of year juveniles commence emigration and duration of emigration.	N/A	
emigration timing peak	Time of year most juveniles are emigrating.	N/A	
size range of juveniles during emigration	Minimum and maximum sizes (inches or mm) of emigrating juveniles. Indicate average size.	N/A	
factors associated with emigration	Pulse flows, water temperature changes, turbidity levels, photoperiod, etc.	N/A	
Other potential factors			
DO	Levels of dissolved oxygen in water expressed in mg/l tolerated by fish.	In excess of 6.0 mg/L dissolved oxygen is needed for growth, and 1-3 mg/L dissolved oxygen is needed for survival (Moyle 2002).	
pH	Alkalinity/acidity of water (expressed in pH) that fish can tolerate.	Smallmouth bass can live at a wide range of pHs, ranging from pH 5.7–9.0 (Moyle 2002).	
turbidity	Indicate turbidity or state of water (e.g., clear water or presence of siltation or organic/inorganic matter in water) that fish can tolerate.		
factors contributing to mortality	e.g., fishing/angling mortality, drastic habitat alterations, unfavorable climatic changes, etc.	Fishing and angling contribute to smallmouth bass mortality (Green 1995).	

References

- Baylis, J. R., D. D. Wiegmann, and M. Hoff. 1993. Alternating Life Histories of Smallmouth Bass. *Transactions of the American Fisheries Society* 500-510.
- Beamesderfer, R. C. P. and J. A. North. 1995. Growth, Natural Mortality, and Predicted Response to Fishing for Largemouth And Smallmouth Bass Populations in North America. *North American Journal of Fisheries Management* 15:688-704.
- Coutant, C. C. and D. L. DeAngelis. 1983. Comparative Temperature Dependent Growth Rates of Largemouth and Smallmouth Bass Fry. *Transactions of the American Fisheries Society* 112:416-423.
- Edwards, E. A., G. Gebhart, and O. E. Maughan. 1983. Habitat Suitability Information: Smallmouth Bass. Report # FWS/OBS-82/10.36. United States Fish and Wildlife Service Bulletin.
- Graham, R. J. and D. J. Orth. 1986. Effects of Temperature And Stream Flow on Time and Duration of Spawning by Smallmouth Bass. *Transactions of the American Fisheries Society* 693-702.
- Green, D. M. 1995. Managing Black Bass in Northern Reservoirs. *North American Journal of Fisheries Management* 15:671-679.
- Lukas, J. A. and D. J. Orth. 1995. Factors Affecting Nesting Success of Smallmouth Bass in a Regulated Virginia Stream. *Transactions of the American Fisheries Society* 726-735.
- Moyle, P. B. 2002. *Inland Fishes of California* Berkeley: University of California Press, 401-404.
- Wang, J. 1986. Interagency Ecological Program Technical Report #9. January 1986. Fishes of the Sacramento-San Joaquin Estuary and Adjacent Waters, California: A Guide to the Early Life Histories. Smallmouth Bass - *Micropterus Dolomieu*.